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71 Applicant: Krumme, John F.
Woodside
San Mateo California(US)

71 Applicant: Hodgson, Darel E.
Palo Alto
Santa Clara California(US)

71 Applicant: McAdams, Ronald E.
Palo Alto
Santa Clara California(US)

72 Inventor: Krumme, John F.
Woodside
San Mateo California(US)

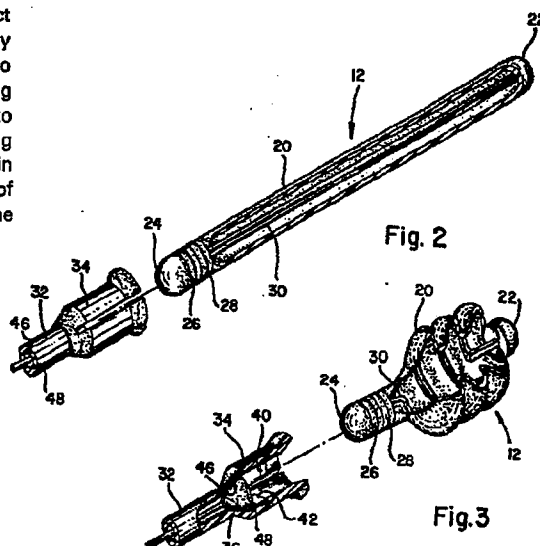
72 Inventor: Hodgson, Darel E.
Palo Alto
Santa Clara California(US)

72 Inventor: McAdams, Ronald E.
Palo Alto
Santa Clara California(US)

74 Representative: Hayward, Denis Edward Peter et al,
Lloyd Wise, Tregear & Co. Norman House 105-109 Strand
London WC2R 0AE(GB)

54 Method of contraception and apparatus for carrying out such method.

57 A non-surgical method of contraception is described which provided for the insertion of an expansible plug (12) through the female reproductive tract into the oviduct. When so positioned, the plug (12) is expanded into sealing contact with the oviduct wall. In turn, the plug can be subsequently collapsed and withdrawn when the contraceptive effect is no longer desired. For carrying out the method, a positioning device (32) is releasably connected to the plug (12) to facilitate its insertion and positioning and cooperating means (24) (26) (30) (34) (40) (42), electrical or mechanical, in the plug (12) and positioning device (32) enable control of plug expansion and/or collapse from the exterior of the female body by the attending physician.



The present invention relates generally to contraceptive techniques and, more particularly, to a method of contraception and apparatus for carrying out such method.

A large number of contraceptive techniques have been developed.

5 Male-utilized condoms and female-utilized diaphragms have been employed for many years but are notably inconvenient and none too effective. Birth control pills are quite effective but have certain adverse side effects that limit their utilization. Intrauterine devices (I.U.D.s) are also generally effective but present problems such as accidental
10 embedding in the uterine wall requiring surgical removal. More recently, devices have been inserted into the oviducts to block or occlude the tube, but, in many cases, require surgical implantation and removal (laparotomy).

In short, all reversible contraceptive techniques, in spite of much
15 development effort, have presented many and varied problems.

It is therefore an object of the present invention to provide a contraceptive method which involves the non-surgical implantation or positioning of a tubal occlusion device in the female oviduct in a manner which assures effective contraception but at the same time enables simple
20 withdrawal of the device when desired.

According to the invention, there is provided a tubal occlusion device which comprises a plug composed of expansible material and arranged to assume an initial laterally collapsed disposition less than the interior diameter of the tube, and means within said plug adapted
25 for actuation to effect lateral expansion of said plug into sealing contact with the walls of the tube.

The tubal occlusion device preferably takes the form of a hollow expansible plug which can be inserted through the female reproductive tract including the vagina, the uterus, and the narrow and convoluted intramural portion of the oviduct into the isthmic ampullary junction.

5 Since both the intramural and isthmic portions of the oviduct are quite small (e.g. 1-4 mm. in diameter) the occlusion device preferably takes the form of a thin elongated cylinder in its collapsed disposition having a diameter no greater than one millimeter to facilitate passage into the oviduct.

10 Once properly positioned, the plug is expanded to provide sealing contact with the wall of the oviduct thus effectively preventing conception.

Subsequently, if plug removal is desired, in accordance with an additional aspect of the invention, the hollow plug can be collapsed
15 to its thin configuration to allow simple withdrawal.

Therefore, according to a further aspect, the invention provides contraceptive apparatus which comprises an expansible hollow plug, an elongated positioning device, means for releasably connecting the ends of said plug and said positioning device, and means cooperatively
20 arranged in said plug and said positioning device for effecting collapse and/or expansion of said plug.

The invention also provides the method of contraception which comprises the steps of positioning an expansible plug in the female oviduct, and expanding the plug into sealing contact with the wall of
25 the oviduct.

For carrying out the method, the contraceptive apparatus is employed which, as mentioned, includes the plug that is hollow and has a collapsed and expanded configuration. Preferably the plug is formed by silicone rubber or other resilient material having no adverse interaction in its contact with the oviduct. In its collapsed form, it takes the form of a narrow elongated cylinder that can easily pass into the oviduct.

Means are provided to effect expansion of the plug laterally outward into sealing contact with the oviduct walls. Preferably such expanded configuration is in the form of a bellows-like structure whose ridges engage and press the walls of the oviduct outwardly. This not only assures sealing contact therewith but also provides frictional engagement effectively precluding longitudinal shifting or dislodgement of the expanded plug in the oviduct.

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1 Such expansion means is a cooperative arrangement in the
2 plug and a positioning device which can be releasably attached
3 to the plug and is sufficiently elongated so as to pass to the
4 exterior of the female for access by the attending physician.

5 In certain embodiments of the invention, the positioning
6 device is arranged not only to enable implantation of the
7 occlusion plug but also, when desired, enable simple collapse
8 and subsequent withdrawal thereof.

9 In one embodiment of the invention, the plug is in the
10 form of a hollow bellows composed of silicone rubber closed at
11 its outer or distal end and sealed at its inner proximal end by
12 a connector enabling releasable connection to an elongated
13 positioning device which the physician can manipulate to enable
14 insertion and positioning within the female oviduct. To
15 facilitate such insertion, a length of shape memory metal, such
16 as that known under the tradename Nitinol, is positioned in
17 extended generally rectilinear configuration within the hollow
18 plug to deform the same into a lengthened and narrowed
19 disposition. After insertion to the desired position within the
20 oviduct, heat is applied to the shape memory metal which effects
21 contraction thereof longitudinally into a generally helical
22 configuration to effect expansion of the plug laterally into
23 its bellow configuration to effect sealing contact with the walls
24 of the oviduct. Preferably, the heat is generated by passing
25 electric current through the shape memory metal in an amount
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1 sufficient to reach its transition temperature and thus effect
2 contraction of the memory metal. The positioning device can then
3 be released from its connection to the plug, which latter will
4 then remain in its laterally expanded and sealing contact with
5 the walls of the oviduct.

6 A second slightly modified embodiment of the invention
7 facilitates removal of the rubber plug when desired. This
8 embodiment also includes a hollow bellows-like plug formed of
9 silicone rubber closed at its outer distal end and connected
10 at its inner proximal end to a suitable connector which enables
11 releasable connection to an elongated positioning device.
12 Electrical connections are made from a suitable source to a
13 Nitinol loop within the hollow plug so that when current is
14 applied to heat the Nitinol, it will assume its shape memory
15 position which is an elongated one which essentially narrows the
16 plug dimensions to facilitate insertion into the oviduct. This
17 elongated disposition of the Nitinol acts in opposition to a thin
18 coil spring which tends to contract and thus acts in opposition
19 to the force exerted by the Nitinol elongation. When the applied
20 heat is removed, such coil spring is sufficiently strong to
21 contract and thus force the hollow plug into its bellows-like
22 configuration wherein sealing contact is made with the oviduct.
23 The positioning device can then be released leaving the plug in
24 its contraceptive position within the oviduct.

1 However, when removal is desired, the positioning device
2 can be again connected by the physician to the proximal end of
3 the plug and current applied to heat the Nitinol and thus extend
4 the same, the force of extension of the Nitinol to its memory
5 shape position being substantially greater than that of the
6 coil spring so that once again the Nitinol is extended and the
7 surrounding silicone rubber returned to its collapsed disposition
8 which obviously will facilitate removal of the plug when the
9 contraceptive effect is no longer desired.

10 In another embodiment of the invention, a mechanical
11 expansion means is employed. More particularly, the occlusive
12 device is normally in the form of a hollow bellows-type structure
13 formed of silicone rubber with its outer distal end closed and
14 its inner proximal end sealingly connected to a flexible reservoir
15 also preferably formed by silicone rubber. In its normal position,
16 the plug takes a thin elongated configuration to facilitate
17 insertion into the oviduct. However, the positioning device
18 includes means which encompasses the reservoir and can be actuated
19 to squeeze the same thus to force fluid therefrom into the plug
20 itself and accordingly expand the plug into a bellows configuration
21 to provide sealing contact with the oviduct. The squeezing of
22 the reservoir can then be released but the expanded configuration
23 of the plug itself is retained through utilization of a
24 releasable check valve located between the reservoir and the
25 plug itself. The plug forming the occlusion device is thus left
26 in its position until removal of the plug is desired.

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1 When such removal is desired, the positioning device is
2 once again inserted into encompassing relationship with the
3 reservoir and a mechanism at its inner extremity can be actuated
4 to open the releasable check valve so that the pressure within
5 the plug is released and will return to its narrow cylindrical
6 configuration so that plug removal is facilitated.

7 In a further embodiment of the invention, a hollow
8 silicone rubber plug is again employed but is arranged to move
9 from its collapsed to expanded disposition in a substantially
10 different manner.

11 More particularly, within the hollow plug, a small hollow
12 conduit is positioned and is provided at spaced intervals with
13 lateral openings. Between these openings, annular sealing
14 members are connected between the central conduit and the
15 exterior plug and a conventional septum is provided at the
16 inner end of the hollow plug which again is closed at its outer
17 extremity.

18 When the plug or occlusion device is to be inserted, a
19 positioning device is releasably connected thereto and includes
20 a central hypodermic needle secured at the extremity of a
21 positioning device and which is arranged to penetrate the
22 septum and after initial insertion and positioning of the plug
23 in a narrow elongated cylindrical form, fluid, hydraulic or
24 pneumatic, can be injected through the needle into the central
25 conduit and its lateral openings so as to expand the silicone
26 rubber plug into a bellows-like configuration so as to seal the
27 oviduct. The positioning device can then be removed and the
28 septum will maintain the plug in its expanded contraceptive
29 position.

1 Subsequently, if the plug is to be removed, the positioning
2 device can again be repositioned with the central needle extending
3 through the septum and with no application of exterior pressure
4 the resiliency of the silicone rubber plug will cause it to
5 collapse into its elongated cylindrical configuration and enable
6 the ready removal of the plug through a simple manual pull on
7 the connecting end of the positioning device.

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9 The stated objective of the invention and the manner in
10 which it is achieved as summarized hereinabove will be more
11 readily understood by reference to the following detailed
12 description of the exemplary structures shown in the accompanying
13 drawings wherein:

14 Fig. 1 is a diagrammatic sectional view of the female
15 reproductive tract indicating insertion of a tubal occlusion
16 device in accordance with the present invention,

17 Fig. 2 is an enlarged fragmentary perspective view of
18 the occlusion device of Fig. 1,

19 Fig. 3 is a perspective view, similar to Fig. 2, but
20 showing the occlusion device in its expanded disposition and the
21 positioning device separated therefrom,

22 Fig. 4 is a fragmentary perspective view of a modified
23 occlusion device in its collapsed disposition with its
24 positioning device attached,

25 Fig. 5 is a view similar to Fig. 4 with the occlusion
26 device in its expanded disposition,

1 Fig. 6 is a fragmentary perspective view similar to Fig. 2
2 and 4 of a modified embodiment of the invention with the
3 occlusion device in its collapsed disposition,

4 Fig. 7 is a view similar to Fig. 6 showing the occlusion
5 unit in its expanded disposition,

6 Fig. 8 is a view similar to Figs. 2, 4 and 6 of a further
7 modified embodiment with the occlusion device in its collapsed
8 disposition, and

9 Fig. 9 is a view similar to Fig. 8 with the occlusion
10 device in its expanded configuration.

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12 With initial reference to Fig. 1 there is illustrated in
13 a sectional showing the reproductive tract of the female including
14 the vaginal channel V, the cervix C, the uterus U and the oviduct
15 or fallopian tubes O.

16 In accordance with the present invention, an elongated
17 positioning device 10 with the tubal occlusion device 12
18 detachably mounted at its extremity has been passed upwardly
19 through the female reproductive tract until the occlusion device
20 itself is positioned in the medial portion of the oviduct O. As
21 shown generally in Fig. 1 and enlarged perspective in Fig. 2,
22 the tubal occlusion device 12 is in the form of a hollow plug 20
23 of silicone rubber which is shown in its longitudinally-extended
24 and laterally-collapsed disposition wherein its diameter is in
25 the neighborhood of 1 millimeter which facilitates implantation
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1 of the plug 20 into the oviduct O which, as previously mentioned,
2 has a diameter in the range of 1 millimeter to 4 millimeters.
3 The outer extremity of the plug 20 is closed by a rounded
4 enclosing tip 22 which also helps to guide the plug into the
5 oviduct when it is inserted by the physician. In turn, the inner
6 end of the hollow plug 20 is sealingly secured to one end of a
7 cylindrical plastic insulated connector 24 also of a very narrow
8 diameter and having two electrodes 26, 28 at spaced positions
9 along its length. These electrodes 26, 28 are joined to the two
10 extremities of a wire loop 30 which is electrically insulated
11 along its length and is formed by thin conductive Nitinol wire
12 which, as shown in Fig. 2, is in substantially a lengthened
13 rectilinear disposition which stretches the silicone rubber plug
14 20 longitudinally so as to laterally effect collapsing of the
15 same into the previously mentioned thin extended disposition
16 with its outer end connected to the tip 22.

17 The Nitinol wire loop 30 is mechanically deformed to this
18 thin elongated substantially rectilinear configuration at a
19 temperature below its transition temperature in its martensitic
20 phase. However, if the Nitinol is then heated to a temperature
21 above its transition temperature so as to reach its austenitic
22 phase, in accordance with its unique shape memory characteristics,
23 it will automatically deform itself into its preset configuration
24 which in the present instance as best shown in Fig. 3 constitutes
25 a foreshortened and widened helical coil which in turn effects
26 foreshortening of the surrounding silicone rubber plug into a
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1 bellows-like configuration whose ridges provide periodic contact
2 with the surrounding walls of the oviduct 0 thus to provide an
3 effective seal and also frictional engagement to preclude
4 movement of the plug along the oviduct channel.

5 With regard to the Nitinol material itself, details of
6 its characteristics can be found in a NASA publication SP5110
7 entitled, "55 Nitinol, The Alloy with a Memory; Its Physical
8 Metallurgy, Properties, and Applications" (1972). Briefly, for
9 present purposes, if the Nitinol is a binary compound having
10 between 50.0 and 50.2 percent of Nickel, with the balance being
11 Titanium, the transition temperature would be in the range of
12 50 to 55 degrees Celsius or 122 to 131 degrees Fahrenheit so
13 that the material can be readily heated to its transition
14 temperature without having any adverse effect on the contacted
15 portions of the reproductive tract. It is to be particularly
16 noted even though the wire is slightly heated above body
17 temperature to provide the transition, it is also enclosed
18 within the silicone rubber so that direct heated contact with
19 the oviduct is not required. It should be additionally mentioned
20 that since 50 degrees Celsius is above normal ambient temperatures,
21 accidental expansion of the plug is avoided.

22 The positioning device, as shown in Fig. 1, is an
23 elongated hollow plastic tube 32 having limited flexibility and
24 a length sufficient so that the plug 20 which is releasably
25 connected to its end can be positioned within the oviduct under
26 control of the physician at a position exterior of the female body.

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1 Releasable mechanical connection is made with the connector 24
2 at the end of the plug 20 by a split-coaxial connector 34 formed
3 by two semi-cylindrical spring fingers also preferably formed by
4 plastic material. The spring action will cause the split fingers
5 to engage the connector 24 at the end of the plug but a conical
6 wedge actuator 36 positioned at the inner end of the coaxial
7 fingers can be pulled by an attached stainless wire puller 38
8 which extends beyond the end of the positioning tube 32 so that a
9 manual pull by the physician will spread the fingers and allow
10 the connection to the connector end of the plug 20 to be released.

11 On the interior of the coaxial fingers, electrical
12 contacts 40, 42 are formed at longitudinally-spaced positions so
13 that when the connection with the connector end of the plug is
14 made, the electrodes 26, 28 are engaged so that electrical
15 current supplied from a suitable source indicated at 44 through
16 thin wires 46, 48 within the positioning tube can be energized
17 to effect heating of the Nitinol loop 30 so that it will be
18 heated above its transition temperature and the wire loop will
19 move from its elongated Fig. 2 position to the helically-coiled
20 and foreshortened disposition of Fig. 3 and, in turn, the
21 surrounding silicone rubber plug 20 will be foreshortened and
22 laterally expanded into contact with the oviduct O as shown
23 clearly in Fig. 3. The physician can at this time pull the
24 wire to spread the coaxial fingers of the coaxial connector 34
25 whereupon the entire positioning device 10 can be withdrawn.

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1 The Nitinol loop 30 will retain its coil-like configuration
2 (Fig. 3) so that the silicone rubber plug 20 remains in secure
3 sealing contact with the surrounding walls of the oviduct thus
4 precluding conception.

5 With reference to Figs. 4 and 5, a slightly modified
6 embodiment of the invention is illustrated. More particularly,
7 the plug 50 is in the form of a hollow tube of silicone rubber
8 which is movable between an extended thin rectilinear disposition
9 shown in Fig. 4 and a laterally expanded bellows-like configura-
10 tion wherein sealing contact is made with the walls of the oviduct
11 0 in a manner similar to that shown in Fig. 1. Within the
12 hollow plug, a loop 52 of Nitinol is again exposed but is
13 arranged so that upon heating above its transition temperature,
14 the loop will attain the longitudinally-extended disposition
15 shown in Fig. 4 which will, in turn, cause the surrounding
16 silicone rubber plug to assume a narrowed elongated disposition as
17 shown in that same Figure. Such elongation of the Nitinol
18 loop 52 and the surrounding plug 50 is opposed by a stainless
19 steel coil spring 54 also positioned within the plug whose
20 strength is insufficient to overcome the elongation of the
21 Nitinol loop 52 when heat is applied thereto. However, after
22 heat is removed, it has sufficient strength to overcome the
23 Nitinol elongation and thus force the plug to a foreshortened
24 disposition which, as indicated clearly in Fig. 5, expands the
25 plug 50 into its bellows-like configuration wherein sealing
26 contact with the walls of the oviduct are again established.

1 To provide for heating of the Nitinol, the loop 52 is
2 connected at its extremities to spaced contacts 56, 58 on a
3 ball connector 60 formed of plastic insulating material which is
4 capable of reception within a split spring socket 62 mounted at
5 the end of a positioning tube 64 generally of the same configura-
6 tion as that described in Fig. 1. The spring socket 62 may be
7 opened by pulling on a wire 66 extending through the positioning
8 tube 64 so as to effect a pull on a wedge-like actuator 68 that
9 opens the socket portion enabling release from the ball connector
10 60 of the plug 50. The interior of the split socket also includes
11 spaced metallic contacts 70, 72 that enable electrical connection
12 to the contacts 56, 58 on the ball when engagement therewith has
13 been achieved through wires 74, 76 extending through the tube to
14 a power source (not shown) under control of the physician as in
15 the first embodiment.

16 In this embodiment of the invention, the end of the
17 positioning device 64 is releasably connected through the ball
18 and socket arrangement described and current is supplied
19 therethrough to the Nitinol to extend it to its Fig. 4
20 disposition enabling insertion into the oviduct. The electrical
21 source is then disconnected which allows the stainless coil
22 spring 54 to act in a foreshortening manner within the plug 50
23 so that it attains the bellows-like configuration shown in Fig. 5
24 whereupon the positioning device can be removed leaving the plug
25 in its contraceptive disposition.

1 However, it should be noted that if the plug 50 is to be
2 removed for any reason, the positioning device 64 can again be
3 connected to the end thereof and current applied which will
4 supply sufficient heating of the Nitinol to again extend it to
5 its Fig. 4 position so that ready removal of the plug 50 from
6 the oviduct is enabled.

7 While the described embodiments of the invention both
8 utilized Nitinol and electrical heating thereof, it will be
9 apparent to those skilled in the art that other forms of heating
10 can be used, direct conductive heating of the Nitinol, inductive
11 heating or many other alternatives.

12 Furthermore, other means can be provided to expand or
13 collapse the tubal occlusion device without the use of Nitinol
14 and, more particularly, with a simple mechanical activation. By
15 way of example, reference is made to Figs. 6 and 7 where a simple
16 hydraulic arrangement is utilized. As shown in Fig. 6, the
17 device includes again a hollow cylindrical plug 80 in its
18 collapsed disposition having a relatively thin elongated
19 disposition with a closed rounded tip 82, the same being formed
20 by silicone rubber of similar material having a predetermined
21 resiliency and the characteristic of not interacting adversely
22 with the walls of the oviduct in which it is again implanted in
23 the manner generally shown in Fig. 1. The inner end of the
24 silicone rubber plug 80 is connected through a releasable one-way
25 valve 84 to a closed hydraulic reservoir 86 also composed of
26 flexible material which normally is just in one-way fluid contact
27 with the plug itself. The reservoir 86 is filled with some
28 hydraulic fluid 88 and if pressure is applied to
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1 such reservoir the fluid will be delivered through the one-way
2 valve 84 into the plug 80 so as to exert interior pressure
3 which expands the plug into its laterally-expanded, bellows-like
4 configuration as shown in Fig. 7.

5 To exert this pressure, an elongated positioning tube 90
6 includes resilient squeezer tips 92 at its inner end that can be
7 moved into encompassing relationship with the reservoir 86 and
8 thence through the release of a wedge actuator 94 connected to
9 a wire 96 encompassed within the positioning plastic tube be
10 released so that the spring squeezer tips 92 will move inwardly
11 into the position shown in Fig. 6 so as to eject the fluid 88
12 through the one-way valve 84 into the occlusion plug 80 to
13 expand the same into its bellows-like configuration where sealing
14 of the oviduct passage is accomplished.

15 In turn, if the plug 80 is to be collapsed to enable
16 removal, another positioning tube 98 as shown in Fig. 7 can be
17 positioned over the reservoir with the spring fingers 100
18 encompassing the one-way valve 84. When a wedge actuator 102
19 is released, the one-way valve is opened whereupon the inherent
20 resiliency of the silicone rubber tube 80 will exhaust the
21 fluid back into the flexible reservoir 86 thus to reduce the
22 lateral dimensions of the plug into the Fig. 6 disposition
23 whereby ready withdrawal can be achieved.

24 Yet another mechanical fluid unit is illustrated in Figs.
25 8 and 9 wherein again a hollow plug 110 is formed by silicone
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1 rubber of a hollow configuration which normally will reside in a
2 narrow elongated disposition such as shown in Fig. 8 with the
3 outer end of the silicone rubber plug closed and a central
4 conduit 112 positioned therewithin that is sealed to the
5 surrounding silicone rubber at longitudinal intervals by annular
6 partitions 114. Between such partitions, the conduit 112 has
7 lateral openings 116 which enable fluid connection between the
8 annular space between the partitions and a source of hydraulic
9 fluid. The inner or proximal end of the plug 110 is closed by
10 a septum 118 which can be penetrated by a hypodermic needle 120
11 secured to the end of a conduit 122 within a positioning tube 124
12 of the type generally described in connection with the previous
13 embodiments of the invention so that fluid, liquid or gaseous can
14 be injected from the exterior of the female through the needle
15 120 into the central conduit 112 so as to expand the silicone
16 rubber to the bellows-like configuration shown in Fig. 9. Split
17 encompassing spring members 126, 128 connected to the end of the
18 positioning tube 124 surround the hypodermic needle and allow
19 connection to the portion of the plug 110 surrounding the septum
20 to enable the initial positioning and also to subsequently
21 enable positioning of the needle through the septum when removal
22 of the plug is desired. In such case, the inherent resiliency
23 of the silicone rubber will force the fluid therewithin out of
24 the plug 110 and if necessary, a vacuum connection (not shown)
25 can be made to the exterior end of the hypodermic needle to
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1 accelerate withdrawal of fluid from the plug and its collapse to
2 the disposition shown in Fig. 8 whereby easy withdrawal of the
3 occlusion plug can be achieved.

CLAIMS:-

1. A tubal occlusion device which comprises
a plug composed of expansible material and arranged to
assume an initial laterally collapsed disposition
less than the interior diameter of the tube, and
5 means within said plug adapted for actuation to effect
lateral expansion of said plug into sealing contact
with the walls of the tube.
2. A tubal occlusion device according to claim 1 wherein
said plug in its collapsed disposition assumes an
elongated generally cylindrical configuration and in
its expanded state assumes a foreshortened bellows
configuration.
3. A tubal occlusion device according to claim 1 wherein
said plug is hollow.
4. A tubal occlusion device according to claim 3 wherein
said plug is composed of resilient material.
5. A tubal occlusion device according to claim 4 wherein
said plug is composed of silicone rubber.
6. A tubal occlusion device according to claim 4 wherein
said plug is adapted upon de-actuation to reassume
automatically its collapsed disposition.
7. A tubal occlusion device according to claim 4 wherein
said hollow resilient plug is arranged to receive fluid
under pressure to effect expansion thereof.

- 1 8. A tubal occlusion device according to claim 7 which comprises
2 a central conduit extending through said hollow resilient
3 plug and having longitudinally-spaced, lateral
4 openings in its wall, and
5 a plurality of annular partitions connecting said central
6 conduit intermediate its openings to the interior wall
7 of said hollow plug,
8 said central conduit being adapted for connection at one
9 end to a source of fluid.
- 10 9. A tubal occlusion device according to claim 8 which comprises
11 valve means adjacent the end of said conduit for
12 controlling communication with the fluid source.
- 13 10. A tubal occlusion device according to claim 4 which comprises
14 an enclosed resilient reservoir communicating with one
15 end of said plug and containing a fluid adapted upon
16 application of exterior compressive forces to effect
17 expansion of said plug into its expanded configuration.
- 18 11. A tubal occlusion device according to claim 3 which comprises
19 a member composed of shape-memory material extending
20 centrally through said hollow plug to normally hold
21 said plug in its laterally-collapsed disposition, but
22 adapted upon the application of heat thereto to
23 effect lateral expansion of said plug into its
24 expanded disposition.
- 25 12. A tubal occlusion device according to claim 11 wherein
26 said shape-memory material is Nitinol.
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13. A tubal occlusion device according to claim 11 wherein
said shape-memory material is electrically conductive, and
which comprises
means connected to said material and adapted to connect
the same to an external source of electrical power
to effect heating thereof.
14. A tubal occlusion device according to claim 13 wherein
said hollow plug is composed of electrically non-conductive
material.
15. A tubal occlusion device according to claim 3 which comprises
a member composed of shape-memory material adapted upon
application of heat to move said plug to its
collapsed disposition, and
spring means automatically operative upon removal of
heat to effect lateral expansion of said plug.
16. Contraceptive apparatus which comprises
an expansible hollow plug,
an elongated positioning device,
means for releasably connecting the ends of said plug and
said positioning device, and
means cooperatively arranged in said plug and said
positioning device for effecting collapse and/or
expansion of said plug.
17. Contraceptive apparatus according to claim 16 wherein
said connecting means includes spring means for
establishing the releasable connection and manually-
operable means for releasing the connection.

18. Contraceptive apparatus according to claim 17 wherein said cooperative means includes a conductive loop of shape-memory material in said plug, a source of electrical power, and means for supplying current from said source to said shape-memory loop.
19. Contraceptive apparatus according to claim 16 wherein said cooperative means includes means for introducing fluid into said hollow plug.
20. The method of contraception which comprises the steps of positioning an expansible plug in the female oviduct, and expanding the plug into sealing contact with the wall of the oviduct.
21. The method of contraception according to claim 20 which comprises the additional step of collapsing the plug when removal is desired.
22. The method of contraception according to claim 20 which comprises the initial step of inserting the plug through the female reproductive tract into the oviduct.
23. The method of contraception according to claim 22 which comprises the additional step of releasably connecting the plug to an elongated positioning device enabling insertion or removal of the plug.

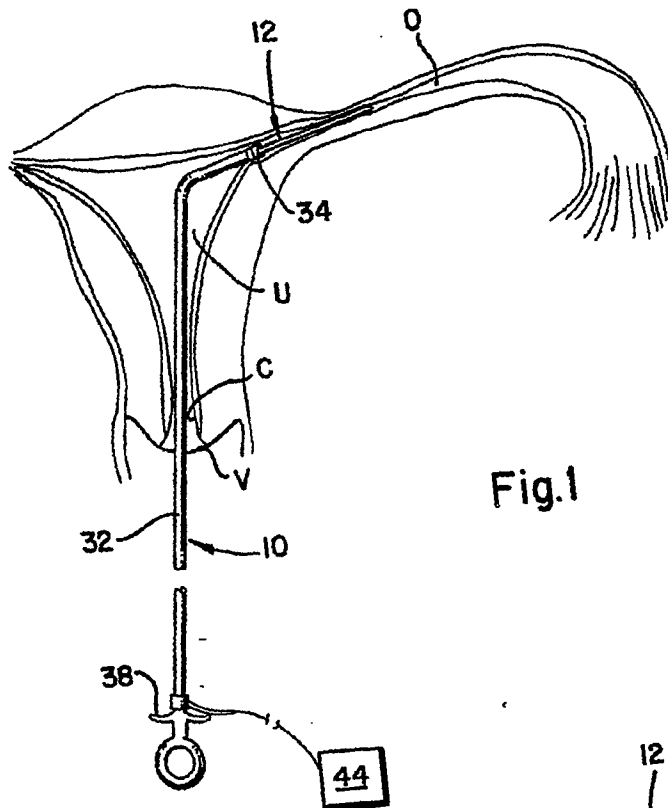


Fig. 1

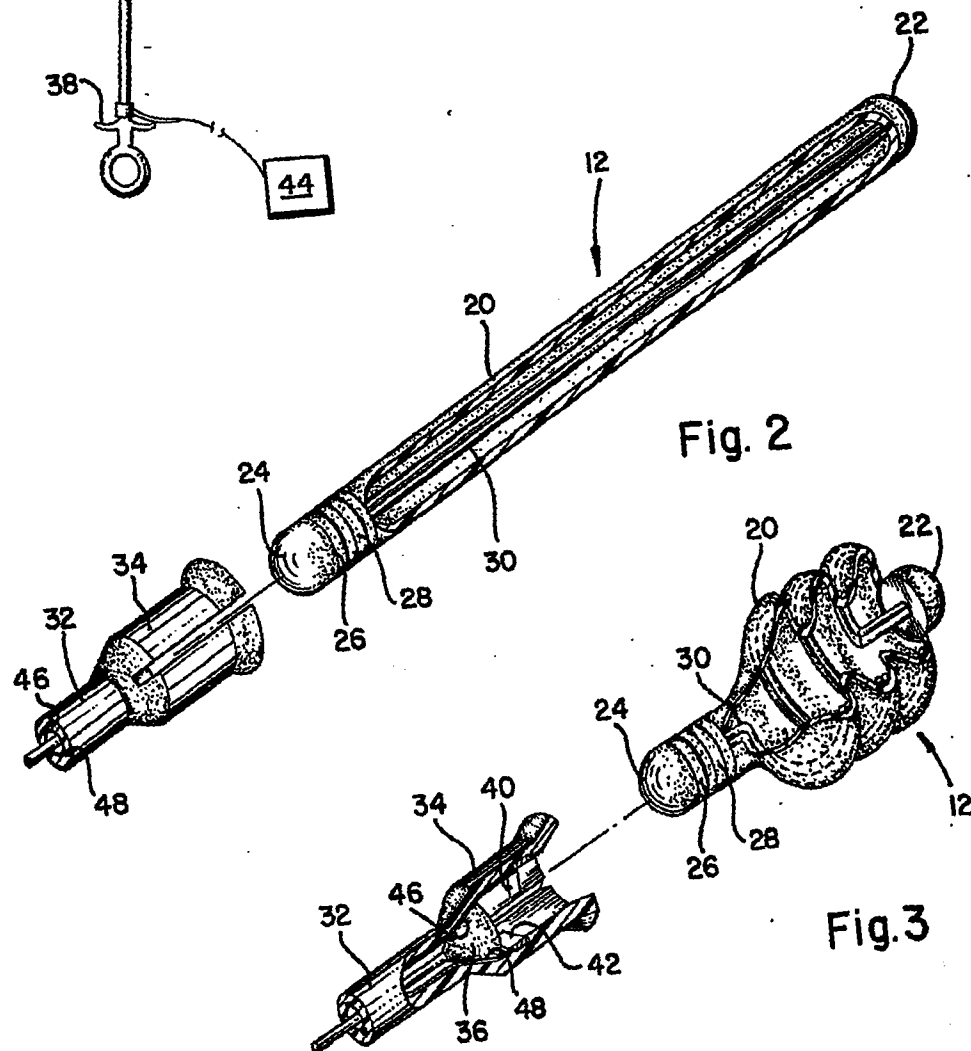
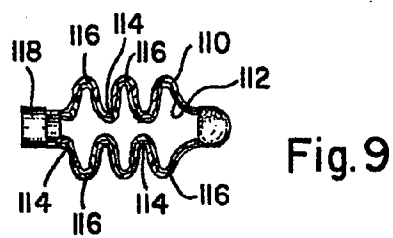
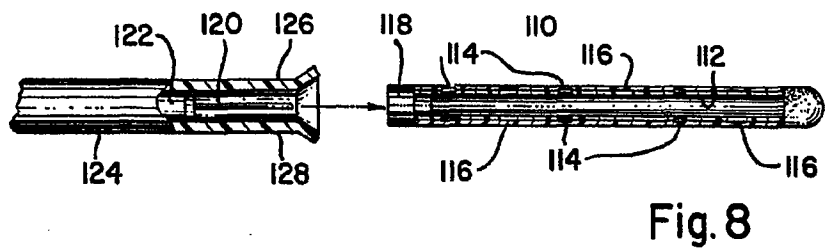
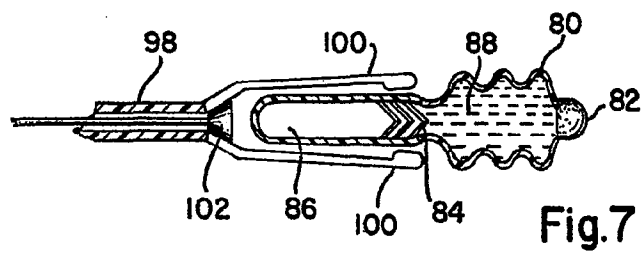
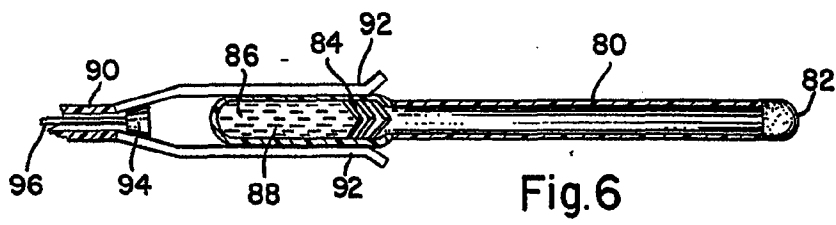
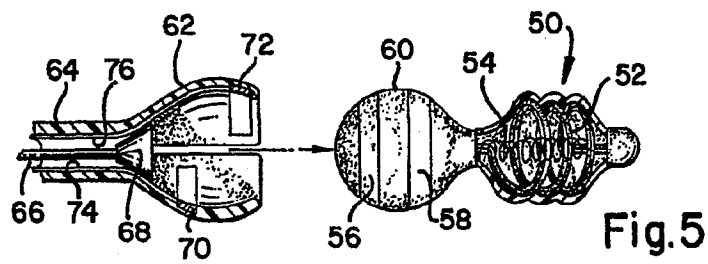
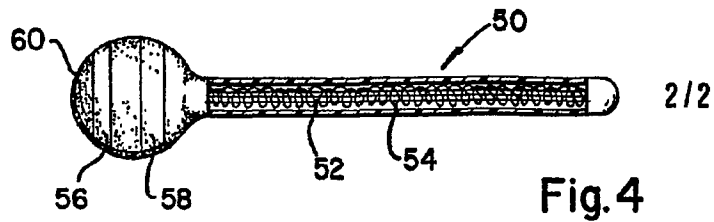


Fig. 2

Fig. 3





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which under Rule 45 of the European Patent Convention
shall be considered, for the purposes of subsequent
proceedings, as the European search report

0105669

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 83305609.6
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X	GB - A - 1 530 565 (EMSET OY) * Totality * --	1,3,4, 7,16, 19	A 61 F 5/46
X	DE - A1 - 2 537 620 (L. POPP) * Totality * --	1,3,4, 7,16, 19	
X	DE - A1 - 2 913 036 (L. POPP) * Fig. 1,1a,2; page 5, para- graph 2 - page 8, paragraph 1 *	1,3,4, 6,16	
X	US - A - 3 722 500 (R. ROBINSON) * Totality * --	1,3,4, 5,7, 10,16, 19	
A	EP - A1 - 0 010 812 (K. VERSCHOOF) * Fig. 1,3,4,5; claims 3,4,10 * --	1,3,4	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			A 61 B 17/00
			A 61 F 5/00
			A 61 M 29/00
			A 61 M 31/00
INCOMPLETE SEARCH The Search Division considers that the present European patent application does not comply with the provisions of the European Patent Convention to such an extent that it is not possible to carry out a meaningful search into the state of the art on the basis of some of the claims. Claims searched completely: 1-19 Claims searched incompletely: Claims not searched: 20-23 Reason for the limitation of the search: in order to Article 52(4)			
Place of search VIENNA		Date of completion of the search 30-12-1983	Examiner LUDWIG
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	



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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	<u>US - A - 2 365 296</u> (M.E. SCHIMPF) * Totality * -----	1,3,4, 7,8,9, 16,19	
			TECHNICAL FIELDS SEARCHED (Int. Cl.)